

# The Emergence of Human Capital Promoting Institutions in the Process of Development\*

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## Abstract

This research suggests that favorable geographical conditions, that were inherently associated with inequality in the distribution of land ownership, adversely affected the implementation of human capital promoting institutions (e.g., public schooling and child labor regulations), and thus the pace and the nature of the transition from an agricultural to an industrial economy, contributing to the emergence of the Great Divergence in income per capita across countries.

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# 1 Introduction

The last two centuries have been characterized by a great divergence in income per capita across the globe. The ratio of GDP per capita between the richest and the poorest regions of the world has widened considerably from a modest 3 to 1 ratio in 1820 to an 18 to 1 ratio in 2001 (Maddison (2001)).<sup>1</sup> The role of geographical and institutional factors, human capital formation, ethnic, linguistic, and religious fractionalization, colonialism and globalization has been the center of a debate about the origin of this remarkable change in the world income distribution.

This paper argues that favorable geographical conditions that were inherently associated with inequality in the distribution of land ownership, adversely affected the emergence of human capital promoting institutions (e.g., public schooling and child labor regulations), and thus the pace and the nature of the transition from an agricultural to an industrial economy, contributing to the emergence of the Great Divergence in income per capita across countries. Consistently with the recent findings of Glaeser, La Porta, Lopez-de-Silanes and Shleifer (2004) about the dominating role of human capital rather than the quality of political institutions in the process of development, the proposed theory underlines the role of human capital, and thus of human capital promoting institutions, in the emergence of the Great Divergence.<sup>2</sup>

The theory further suggests that the qualitative change in the role of land in the process of industrialization created changes in the ranking of countries in the world income distribution. Some land abundant countries which were associated with the club of the rich economies in the pre-industrial revolution era and were characterized by an unequal distribution of land, were overtaken in the process of industrialization by land scarce countries and were dominated by other land abundant economies in which land distribution was rather equal.

The accumulation of physical capital has raised the importance of human capital in the process of industrialization, reflecting the complementarity between capital and skills. Investment in human capital, however, has been sub-optimal due to credit markets imperfections, and public investment in education has been therefore growth enhancing.<sup>3</sup> Nevertheless, human

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<sup>1</sup>Some researchers (e.g., Jones (1997) and Pritchett (1997)) have demonstrated that this diverging pattern persisted in the last decades as well. Interestingly, however, as established by Sala-i-Martin (2002), the phenomena has not been maintained across people in the world (i.e., when national boundaries are removed).

<sup>2</sup>The significant role of human capital in economic growth is documented in Barro (1991) as well as others. Studies based on growth accounting methods generate conflicting evidence about the direct role of human capital in the growth process. Most of the existing studies (e.g., Hall and Jones (1999)), attribute the differences in income per-capita across countries largely to differences in TFP, whereas some (e.g., Manuali and Seshadri (2005)) provide evidence in favor of the dominating role of human capital. Nevertheless, it should be noted that even if the direct role of human capital is limited, as established by Glaeser et al. (2004), it has a large indirect effect on growth via its effect on technological progress and the implementation of growth enhancing institution.

<sup>3</sup>See Galor and Zeira (1993), Fernandez and Rogerson (1996), and Benabou (2000).

capital accumulation has not benefited all sectors of the economy. Due to a low degree of complementarity between human capital and land,<sup>4</sup> universal public education has increased the cost of labor beyond the increase in the average labor productivity in the agricultural sector, reducing the return to land. Landowners, therefore, had no economic incentives to support these growth enhancing educational policies as long as their stake in the productivity of the industrial sector was insufficient.<sup>5</sup>

The theory suggests that the adverse effect of the implementation of universal public education on landowners' income from agricultural production is magnified by the concentration of land ownership.<sup>6</sup> Hence, as long as landowners have affected the political process and thereby the implementation of education reforms, inequality in the distribution of land ownership has been a hurdle for human capital accumulation slowing the process of industrialization and the transition to modern growth.<sup>7</sup> In these economies an inefficient education policy persisted and the growth path was retarded. In contrast, in societies in which agricultural land was scarce or land ownership was distributed rather equally, growth enhancing education policies were implemented.<sup>8</sup>

The process of industrialization fueled by the accumulation of physical capital, has raised the interest of landowners in the productivity of the industrial sector and brought about a qualitative change in landowners' attitudes towards education reforms. In particular, economies

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<sup>4</sup>Although, rapid technological change in the agricultural sector may increase the return to human capital (e.g., Foster and Rosenzweig (1996)), the return to education is typically lower in the agricultural sector, as evident by the distribution of employment in the agricultural sector. For instance, as reported by the U.S. department of Agriculture (1998), 56.9% of agricultural employment consists of high school dropouts, in contrast to an average of 13.7% in the economy as a whole. Similarly, 16.6% of agricultural employment consists of workers with 13 or more years of schooling, in contrast to an average of 54.5% in the economy as a whole.

<sup>5</sup>Landowners, as well as other owners of factors of production, influence the level of public schooling but are limited in their power to levy taxes for their own benefit. Otherwise, following the Coasian Theorem, the landed elite would prefer an optimal level of education, taxing the resulting increase in aggregate income. Nevertheless, landowners may benefit from the economic development of other segments of the economy due to capital ownership, household's labor supply to the industrial sector, the provision of public goods, and demand spillover from economic development of the urban sector.

<sup>6</sup>The proposed mechanism focuses on the emergence of public education. Alternatively, one could have focused on child labor regulation, linking it to human capital formation as in Doepke and Zilibotti (2005), or on the endogenous abolishment of slavery (e.g., Lagerlof (2003)) and the incentives it creates for investment in human capital.

<sup>7</sup>Consistently with the proposed theory, Deininger and Squire (1998) document that the level of education and economic growth over the period 1960-1992 are inversely related to land inequality (across landowners) and the relationship is more pronounced in developing countries.

<sup>8</sup>The adverse relationship between natural resources and growth is documented even in smaller time frames. Sachs and Warner (1995) and Gylfason (2001) document a significant inverse relationship between natural resources and growth in the post World-War II era. Gylfason finds that a 10% increase in the amount of natural capital is associated with a fall of about 1% in the growth rate. Furthermore, based on a cross section study, he reports significant negative relationships between the share of natural capital in national wealth, and public spending on education, expected years of schooling, and secondary-school enrollments, concluding that natural resources crowd out human capital formation.

in which land was equally distributed implemented earlier growth-enhancing public education, leading to the emergence of a skill-intensive industrial sector and a rapid process of development. In contrast, among economies marked by an unequal distribution of land ownership, land abundance that was a source of richness in early stages of development, led in later stages to under-investment in human capital, unskilled-intensive industrial sector, and a slower growth process.<sup>9</sup> Thus, variations in the distribution of land ownership across countries generated variations in the industrial composition of the economy, and thereby the observed diverging growth patterns across the globe.<sup>10</sup>

Evidence suggests that indeed the distribution of land within and across countries affected the nature of the transition from an agrarian to an industrial economy and has been significant in the emergence of sustained differences in human capital, income levels, and growth patterns across countries.<sup>11</sup> The link between land reforms and the increase in governmental investment in education that is apparent in the process of development of several countries lends credence to the proposed theory.

The process of development in Korea was marked by a major land reform followed by a massive increase in governmental expenditure on education. During the Japanese occupation in the period 1905-1945, land distribution in Korea became increasingly skewed and in 1945 nearly 70% of Korean farming households were simply tenants [Eckert, 1990]. In 1949, the Republic of Korea instituted the Agricultural Land Reform Amendment Act that drastically affected landholdings. Owner cultivated farm households increased from 349,000 in 1949 to 1,812,000 in 1950, and tenant farm households declined from 1,133,000 in 1949 to nearly zero in 1950 [Yoong, 2000]. Consistent with the proposed theory, following the decline in the inequality in the distribution of land, expenditure on education soared. In 1948, Korea allocated 8% of government expenditures to education. Following a slight decline due to the Korean war, educational expenditure has increased to 9.2% in 1957 and 14.9% in 1960, remaining at about 15% thereafter. Land reforms and the subsequent increase in governmental investment in education were followed by a stunning growth performance that permitted Korea to nearly triple

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<sup>9</sup>According to the theory, therefore, land reform would bring about an increase in the investment in human capital. The differential increase in the productivity of workers in the industrial and the agricultural sectors would generate migration from the agricultural to the industrial sector accompanied by an increase in agricultural wages and a decline in agricultural employment. Consistent with the proposed theory, Besley and Burgess (2000) find that over the period 1958-1992 in India, land reforms have raised agricultural wages, despite an adverse effect on agricultural output.

<sup>10</sup>As established by Chanda and Dalgaard (2003), variations in the structural composition of economies and in particular the allocation of scarce inputs between the agriculture and the non-agriculture sectors are important determinants of international differences in TFP, accounting for between 30 and 50 percents of these variations.

<sup>11</sup>See Gerber (1991), Coleman and Caselli (2001) and Bertocchi (2002) as well.

its income relative to the United States in about twenty years, from 9% in 1965 to 25% in 1985. Hence, consistently with the proposed theory, prior to its land reforms Korea's income level was well below that of land-abundant countries in North and South America. However, in the aftermath of the Korean's land reform and the subsequent rise in human capital accumulation, Korea overtook some land abundant countries in South America that were characterized by an unequal distribution of land.

North and South America provide anecdotal evidence for differences in the process of development, and possibly overtaking, due to the effects of the distribution of land ownership on education reforms within land-abundant economies. As argued by Engerman and Sokoloff (2000) the original colonies in North and South America had vast amounts of land per person and income levels comparable to the European ones. North and Latin America differed in the distribution of land and resources. The United States and Canada were deviant cases in their relatively egalitarian distribution of land. For the rest of the new world, land and resources were concentrated in the hand of a very few, and this concentration persisted over a very long period.<sup>12</sup> Consistent with the proposed theory, these differences in land distribution between North and Latin America, were associated with significant differences in investment in human capital. As argued by Coatsworth (1993 pp 26-7) in the US there was a widespread property ownership, early public commitment to educational spending, and a lesser degree of concentration of wealth and income whereas in Latin America public investment in human capital remained well below the levels achieved at comparable levels of national income in more developed countries.<sup>13</sup> Furthermore, Engerman and Sokoloff (2000) maintain that although all of the economies in the western hemisphere were rich enough in the early 19th century to have established primary schools, only the United States and Canada made the investments necessary to educate the general population.

The proposed theory further suggests that the divergence in the growth performance of North and Latin America in the second half of the twentieth century, (e.g., Argentina, Brazil, Chile and Mexico vs. the US and Canada), may be attributed in part to the more equal distribution of land in the North, whereas the overtaking (e.g., Mexico and Columbia overtaken by Korea and Taiwan) may be attributed to the positive effect of land abundance in early stages of development and the adverse effect of its unequal distribution in later stages of development.

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<sup>12</sup>For instance, in Mexico in 1910, 0.2% of the active rural population owned 87% of the land [Estevo, 1983].

<sup>13</sup>As argued by Engerman and Sokolof (2000), even among Latin American countries variations in the degree of inequality in the distribution of land ownership were reflected in variation in investment in human capital. In particular, Argentina, Chile and Uruguay in which land inequality was less pronounced invested significantly more in education.

Moreover, Nugent and Robinson (2002) show that in Costa Rica and Colombia where coffee is typically grown in small farms (reflecting lower inequality in the distribution of land) income and human capital are significantly higher than that of Guatemala and El Salvador where coffee plantations are rather large.<sup>14</sup>

## 2 Related Literature

The role of institutional factors has been the focus of an influential hypothesis regarding the origin of the great divergence. North (1981), Landes (1998), Mokyr (1990, 2002), Parente and Prescott (2000), and Acemoglu, Johnson and Robinson (2002) have argued that institutions that facilitated the protection of property rights, enhancing technological research and the diffusion of knowledge, have been the prime factor that enabled the earlier European take-off and the great technological divergence across the globe.<sup>15</sup>

The effect of geographical factors on economic growth and the great divergence have been emphasized by Jones (1981), Diamond (1997) and Sachs and Werner (1995).<sup>16</sup> The geographical hypothesis suggests that more favorable geographical conditions made Europe less vulnerable to the risk associated with climate and diseases, leading to the early European take-off, whereas adverse geographical conditions in disadvantageous regions, generated permanent hurdles for the process of development, contributing to the great divergence.<sup>17</sup>

The exogenous nature of the geographical factors and the inherent endogeneity of the institutional factors lead researchers to hypothesize that initial geographical conditions had a persistent effect on the quality of institutions, leading to divergence and overtaking in economic performance. Engerman and Sokolof (2000) provide descriptive evidence that geographical conditions that led to income inequality, brought about oppressive institutions (e.g., restricted access to the democratic process) designed to maintain the political power of the elite and to preserve the existing inequality, whereas geographical characteristics that generated an equal distribu-

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<sup>14</sup>In contrast to the proposed theory, Nugent and Robinson (2002) suggest that a holdup problem generated by the monopsony power in large plantations prevents commitment to reward investment in human capital, whereas small holders can capture the reward to human capital and have therefore the incentive to invest. Moreover, unlike our theory, their mechanism does not generate the economic forces that permit the economy to escape this institutional trap.

<sup>15</sup>Divergence could also emerge from differences in legal origins (Gleaser and Shleifer (2002)). Barriers to technological adoption that may lead to divergence are explored by Howitt and Mayer-Foulkes (2005) and Acemoglu, Aghion and Zilibotti (2005).

<sup>16</sup>See Hall and Jones (1999), Masters and McMillan (2001) and Hibbs and Olson (2004) as well.

<sup>17</sup>Bloom, Canning and Sevilla (2003) reject, in a cross section analysis, the geographical determinism, but maintain nevertheless that favorable geographical conditions have mattered for economic growth since they increased the likelihood of an economy to escape a poverty trap.

tion of income led to the emergence of growth promoting institutions. Acemoglu, Johnson and Robinson (2002) provide evidence that reversals in economic performance across countries have a colonial origin, reflecting institutional reversals that were introduced by European colonialism across the globe.<sup>18</sup> “Reversals of fortune” reflect the imposition of extractive institutions by the European colonialists in regions where favorable geographical conditions led to prosperity, and the implementation of growth enhancing institutions in poorer regions.<sup>19</sup> Furthermore, the role of ethnic, linguistic, and religious fractionalization in the emergence of divergence and “growth tragedies” has been linked to their effect on the quality of institutions (Easterly and Levine (1997)).

The role of human capital in the process of development is underlined in the unified growth theories of Galor and Weil (2000), Galor and Moav (2002, 2004), Galor and Mountford (2003), Doepke (2004), Lagerlof (2004), as well as others. These theories establish theoretically and quantitatively that the rise in the technologically driven demand for human capital in the second phase of industrialization and its effect on human capital formation and on the onset of the demographic transitions have been the prime forces in the transition from stagnation to growth and thus in the emergence of the associated phenomena of the great divergence.

Empirical research is inconclusive about the significance of institutional factors in the process of development. Some researchers suggest that initial geographical conditions affected the current economic performance primarily via their effect on institutions. Acemoglu, Johnson and Robinson (2002), Easterly and Levine (2003), and Rodrik, Subramanian and Trebbi (2004) provide evidence that variations in the contemporary growth processes across countries can be attributed to institutional factors whereas geographical factors operate primarily via variations in institutions. Moreover, Easterly and Levine (1997) and Alesina et al. (2003) demonstrate that geopolitical factors brought about a high degree of fractionalization in some regions of the world, leading to the implementation of institutions that are not conducive for economic growth and thereby to diverging growth paths across regions.

Glaeser, La Porta, Lopez-de-Silanes and Shleifer (2004) revisit the debate whether political institutions cause economic growth, or whether, alternatively, growth and human capital accumulation lead to institutional improvement. In contrast to earlier studies, they find that human capital is a more fundamental source of growth than political institutions (i.e., risk of

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<sup>18</sup>Additional aspects of the role of colonialism in comparative developments are analyzed by Bertocchi and Canova (2002).

<sup>19</sup>Brezis, Krugman and Tsiddon (1993), in contrast, attribute technological leapfrogging to the acquired comparative advantage (via learning by doing) of the current technological leaders in the use of the existing technologies.

expropriation by the government, government effectiveness, and constraints on the executives). Moreover, they argue that poor countries emerge from poverty through good policies (e.g., human capital promoting policies) and only subsequently improve their political institutions.

In contrast to the earlier literature on the role of human capital in the process of development, the proposed theory endogenizes the formation of human capital promoting institutions, underlining the role of the distribution of land ownership in the variations in the emergence of public education, and thereby in the Great Divergence. It generates predictions that are consistent with the recent findings of Glaeser et al. (2004) about the dominating role of human capital, rather than the quality of political institutions, in the process of development, as well as with the evidence regarding the effect of land inequality on human capital formation and economic growth.

The proposed theory differs in several important dimensions from the earlier analysis by Engerman and Sokolof (2000) of the relationship between geographically-based inequality and institutions. First, the theory suggests that a conflict of interest among the economic elites i.e., industrialists and landowners (rather than between the ruling elite and the masses as argued by Engerman and Sokolof) brought about the delay in the implementation of growth enhancing educational policies. Second, consistent with existing cross sectional evidence, the theory underlines the adverse effect of unequal distribution of land ownership (rather than wealth inequality as suggested by Engerman and Sokolof) in the timing of educational reforms. Third, the theory focuses on the direct economic incentive (i.e., the adverse effect of education reforms on the land rental rate) that induces the landed elite to block education reforms, rather than on the effect of reforms on the distribution of political power and thus the degree of rent extraction. Forth, in contrast to Engerman and Sokolof's static viewpoint of the desirability of extractive institutions for the ruling elite, the proposed theory suggests that the desirability of the implementation of efficient institutions may gradually emerge in the process of development, generating the observed variations in the timing of growth promoting educational reforms.<sup>20</sup>

A complementary approach suggests that interest groups (e.g., landed aristocracy and monopolies) block the introduction of new technologies and superior institutions in order to protect their political power and thus maintain their rent extraction. Olson (1982), Mokyr (1990), Parente and Prescott (2000), and Acemoglu and Robinson (2002) argue that this type

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<sup>20</sup>In contrast to the political economy mechanism proposed by Persson and Tabellini (2000), where land concentration induces landowners to divert resources in their favor via distortionary taxation, in the proposed theory land concentration induces lower taxation so as to assure lower public expenditure on education, resulting in a lower economic growth. The proposed theory is therefore consistent with empirical findings that taxation is positively related to economic growth and negatively to inequality (e.g., Benabou (1996) and Perotti (1996)).



of conflict, in the context of technology adoption, has played an important role throughout the evolution of industrial societies.<sup>21</sup> Interestingly, the political economy interpretation of our theory suggests, in contrast, that the industrial elite would relinquish power to the masses in order to overcome the desire of the landed elite to block economic development.<sup>22</sup>

### 3 The Basic Structure of the Model

Consider an overlapping-generations economy in a process of development. In every period the economy produces a single homogeneous good that can be used for consumption and investment. The good is produced in an agricultural sector and in a manufacturing sector using land, physical and human capital as well as raw labor. The stock of physical capital in every period is the output produced in the preceding period net of consumption and human capital investment, whereas the stock of human capital in every period is determined by the aggregate public investment in education in the preceding period. The supply of land is fixed over time and output grows due to the accumulation of physical and human capital.

#### 3.1 Production of Final Output

The output in the economy in period  $t$ ,  $y_t$ , is given by the aggregate output in the agricultural sector,  $y_t^A$ , and in the manufacturing sector,  $y_t^M$ ;

$$y_t = y_t^A + y_t^M. \quad (1)$$

##### 3.1.1 The Agricultural Sector

Production in the agricultural sector occurs within a period according to a neoclassical, constant-returns-to-scale production technology, using labor and land as inputs. The output produced at time  $t$ ,  $y_t^A$ , is

$$y_t^A = F(X_t, L_t), \quad (2)$$

where  $X_t$  and  $L_t$  are land and the number of workers, respectively, employed by the agricultural sector in period  $t$ . Hence, workers' productivity in the agricultural sector is independent of their level of human capital. The production function is strictly increasing and concave, the two factors are complements in the production process,  $F_{XL} > 0$ , and the function satisfies

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<sup>21</sup>Barriers to technological adoption that may lead to divergence are explored by Caselli and Coleman (2002), Howitt and Mayer-Foulkes (2002) and Acemoglu, Aghion and Zilibotti (2003) as well.

<sup>22</sup>See Lizzeri and Persico (2004) as well.

the neoclassical boundary conditions that assure the existence of an interior solution to the producers' profit-maximization problem.<sup>23</sup>

Producers in the agricultural sector operate in a perfectly competitive environment. Given the wage rate per worker,  $w_t^A$ , and the rate of return to land,  $\rho_t$ , producers in period  $t$  choose the level of employment of labor,  $L_t$ , and land,  $X_t$ , so as to maximize profits. That is,  $\{X_t, L_t\} = \arg \max [F(X_t, L_t) - w_t L_t - \rho_t X_t]$ . The producers' inverse demand for factors of production is therefore,

$$\begin{aligned} w_t^A &= F_L(X_t, L_t); \\ \rho_t &= F_X(X_t, L_t). \end{aligned} \tag{3}$$

### 3.1.2 Manufacturing Sector

Production in the manufacturing sector occurs within a period according to a neoclassical, constant-returns-to-scale, Cobb-Douglas production technology using physical and human capital as inputs. The output produced at time  $t$ ,  $y_t^M$ , is

$$y_t^M = K_t^\alpha H_t^{1-\alpha} = H_t k_t^\alpha; \quad k_t \equiv K_t/H_t; \quad \alpha \in (0, 1), \tag{4}$$

where  $K_t$  and  $H_t$  are the quantities of physical capital and human capital (measured in efficiency units) employed in production at time  $t$ . Both factors depreciate fully after one period. In contrast to the agricultural sector, human capital has a positive effect on workers' productivity in the manufacturing sector, increasing workers' efficiency units of labor.

Producers in the manufacturing sector operate in a perfectly competitive environment. Given the wage rate per efficiency unit of human capital,  $w_t^M$ , and the rate of return to capital,  $R_t$ , producers in period  $t$  choose the level of employment of capital,  $K_t$ , and the number of efficiency units of human capital,  $H_t$ , so as to maximize profits. That is,  $\{K_t, H_t\} = \arg \max [K_t^\alpha H_t^{1-\alpha} - w_t^M H_t - R_t K_t]$ . The producers' inverse demand for factors of production is therefore

$$\begin{aligned} R_t &= \alpha k_t^{\alpha-1} \equiv R(k_t); \\ w_t^M &= (1-\alpha) k_t^\alpha \equiv w^M(k_t). \end{aligned} \tag{5}$$

## 3.2 Individuals

In every period a generation which consists of a continuum of individuals of measure 1 is born. Individuals live for two periods. Each individual has a single parent and a single child. Individ-

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<sup>23</sup>The abstraction from technological change is merely a simplifying assumption. The introduction of endogenous technological change would allow output in the agricultural sector to increase over time despite the decline in the number of workers in this sector.

uals, within as well as across generations, are identical in their preferences and innate abilities but they may differ in their wealth.

Preferences of individual  $i$  who is born in period  $t$  (a member  $i$  of generation  $t$ ) are defined over second period consumption,<sup>24</sup>  $c_{t+1}^i$ , and a transfer to the offspring,  $b_{t+1}^i$ .<sup>25</sup> They are represented by a log-linear utility function

$$u_t^i = (1 - \beta) \log c_{t+1}^i + \beta \log b_{t+1}^i, \quad (6)$$

where  $\beta \in (0, 1)$ .

In the first period of their lives individuals devote their entire time for the acquisition of human capital. In the second period of their lives individuals join the labor force, allocating the resulting wage income, along with their return to capital and land, between consumption and income transfer to their children. In addition, individuals transfer their entire stock of land to their offspring.

An individual  $i$  born in period  $t$  receives a transfer,  $b_t^i$ , in the first period of life. A fraction  $\tau_t \geq 0$  of this capital transfer is collected by the government in order to finance public education, whereas a fraction  $1 - \tau_t$  is saved for future income. Individuals devote their first period for the acquisition of human capital. Education is provided publicly free of charge. The acquired level of human capital increases with the real resources invested in public education. The number of efficiency units of human capital of each member of generation  $t$  in period  $t + 1$ ,  $h_{t+1}$ , is a strictly increasing, strictly concave function of the government real expenditure on education per member of generation  $t$ ,  $e_t$ .<sup>26</sup>

$$h_{t+1} = h(e_t), \quad (7)$$

where  $h(0) = 1$ ,  $\lim_{e_t \rightarrow 0^+} h'(e_t) = \infty$ , and  $\lim_{e_t \rightarrow \infty} h'(e_t) = 0$ . Hence, even in the absence of real expenditure on public education individuals possess one efficiency unit of human capital - basic skills.

In the second period life, members of generation  $t$  join the labor force earning the competitive market wage  $w_{t+1}$ . In addition, individual  $i$  derives income from capital ownership,  $b_t^i(1 - \tau_t)R_{t+1}$ , and from the return on land ownership,  $x^i \rho_{t+1}$ , where  $x^i$  is the quantity of land

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<sup>24</sup>For simplicity we abstract from first period consumption. It may be viewed as part of the consumption of the parent.

<sup>25</sup>This form of altruistic bequest motive (i.e., the “joy of giving”) is the common form in the recent literature on income distribution and growth. It is supported empirically by Altonji, Hayashi and Kotlikoff (1997).

<sup>26</sup>A more realistic formulation would link the cost of education to (teacher’s) wages, which may vary in the process of development. As can be derived from section 2.4, under both formulations the optimal expenditure on education,  $e_t$ , is an increasing function of the capital-labor ratio in the economy, and the qualitative results remain therefore intact.

owned by individual  $i$ . The individual's second period income,  $I_{t+1}^i$ , is therefore

$$I_{t+1}^i = w_{t+1} + b_t^i(1 - \tau_t)R_{t+1} + x^i\rho_{t+1}. \quad (8)$$

A member  $i$  of generation  $t$  allocates second period income between consumption,  $c_{t+1}^i$ , and transfers to the offspring,  $b_{t+1}^i$ , so as to maximize utility subject to the second period budget constraint

$$c_{t+1}^i + b_{t+1}^i \leq I_{t+1}^i. \quad (9)$$

Hence the optimal transfer of a member  $i$  of generation  $t$  is,<sup>27</sup>

$$b_{t+1}^i = \beta I_{t+1}^i. \quad (10)$$

The indirect utility function of a member  $i$  of generation  $t$ ,  $v_t^i$  is therefore

$$v_t^i = \log I_{t+1}^i + \xi \equiv v(I_{t+1}^i), \quad (11)$$

where  $\xi \equiv (1 - \beta) \log(1 - \beta) + \beta \log \beta$ . The indirect utility function is monotonically increasing in  $I_{t+1}^i$ .

### 3.3 Physical Capital, Human Capital, and Output

Let  $B_t$  denote the aggregate level of intergenerational transfers in period  $t$ . It follows from (8) and (10) that,

$$B_t = \beta y_t. \quad (12)$$

A fraction  $\tau_t$  of this capital transfer is collected by the government in order to finance public education, whereas a fraction  $1 - \tau_t$  is saved for future consumption. The capital stock in period  $t + 1$ ,  $K_{t+1}$ , is therefore

$$K_{t+1} = (1 - \tau_t)\beta y_t, \quad (13)$$

whereas the government tax revenues are  $\tau_t\beta y_t$ .

Since population is normalized to 1, the education expenditure per young individual in period  $t$ ,  $e_t$ , is,

$$e_t = \tau_t\beta y_t, \quad (14)$$

and the stock of human capital, employed in the manufacturing sector in period  $t + 1$ ,  $H_{t+1}$ , is therefore,

$$H_{t+1} = \theta_{t+1}h(\tau_t\beta y_t), \quad (15)$$

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<sup>27</sup>Note that individual's preferences defined over the transfer to the offspring,  $b_t^i$ , or over net transfer,  $(1 - \tau_t)b_t^i$ , are represented in an indistinguishable manner by the log linear utility function. Under both definitions of preferences the bequest function is given by  $b_{t+1}^i = \beta I_{t+1}^i$ .

where,  $\theta_{t+1}$  is the fraction (and the number) of workers employed in the manufacturing sector. Hence, output in the manufacturing sector in period  $t + 1$  is,

$$y_{t+1}^M = [(1 - \tau_t)\beta y_t]^\alpha [\theta_{t+1}h(\tau_t\beta y_t)]^{1-\alpha} \equiv y^M(y_t, \tau_t, \theta_{t+1}) \quad (16)$$

and the physical-human capital ratio  $k_{t+1} \equiv K_{t+1}/H_{t+1}$  is,

$$k_{t+1} = \frac{(1 - \tau_t)\beta y_t}{\theta_{t+1}h(\tau_t\beta y_t)} \equiv k(y_t, \tau_t, \theta_{t+1}), \quad (17)$$

where  $k_{t+1}$  is strictly decreasing in  $\tau_t$  and in  $\theta_{t+1}$ , and strictly increasing in  $y_t$ . As follows from (5), the capital share in the manufacturing sector is

$$(1 - \tau_t)\beta y_t R_{t+1} = \alpha y_{t+1}^M, \quad (18)$$

and the labor share in the manufacturing sector is given by

$$\theta_{t+1}h(\tau_t\beta y_t)w_{t+1}^M = (1 - \alpha)y_{t+1}^M. \quad (19)$$

The supply of labor to agriculture,  $L_{t+1}$ , is equal to  $1 - \theta_{t+1}$ . Output in the agriculture sector in period  $t + 1$  is therefore

$$y_{t+1}^A = F(X, 1 - \theta_{t+1}) \equiv y^A(\theta_{t+1}; X) \quad (20)$$

As follows from the properties of the production functions as long as,  $X > 0$ , and  $\tau_t < 1$ , noting that  $y_t > 0$  for all  $t$ , both sectors are active in  $t + 1$ . Hence, since individuals can either supply one unit of labor to the agriculture sector and receive the wage  $w_{t+1}^A$  or supply  $h_{t+1}$  units of human capital to the manufacturing sector and receive the wage income  $h_{t+1}w_{t+1}^M$  it follows that

$$w_{t+1}^A = h_{t+1}w_{t+1}^M \equiv w_{t+1}, \quad (21)$$

and the division of labor between the two sectors,  $\theta_{t+1}$ , noting (3), (5) and (17) is determined accordingly.

Since the number of individuals in each generation is normalized to 1, aggregate wage income in the economy, which equals to the sum of labor shares in the two sectors, equals  $w_{t+1}$ . Namely, as follows from (3), (19) and (20),

$$w_{t+1} = (1 - \theta_{t+1})F_L(X, 1 - \theta_{t+1}) + (1 - \alpha)y_{t+1}^M. \quad (22)$$

**Lemma 1** *The fraction of workers employed by the manufacturing sector in period  $t + 1$ ,  $\theta_{t+1}$  :  
(a) is uniquely determined:*

$$\theta_{t+1} = \theta(y_t, \tau_t; X),$$

where  $\theta_X(y_t, \tau_t; X) < 0$ ,  $\theta_y(y_t, \tau_t; X) > 0$ , and  $\lim_{y \rightarrow \infty} \theta(y_t, \tau_t; X) = 1$ .

(b) maximizes the aggregate wage income,  $w_{t+1}$ , and output  $y_{t+1}$  in period  $t + 1$  :

$$\theta_{t+1} = \arg \max w_{t+1} = \arg \max y_{t+1}.$$

**Proof.**

(a) Substitution (3), (5), and (17) into (21) it follows that

$$F_L(X, 1 - \theta_{t+1}) = h(\tau_t \beta y_t)(1 - \alpha) \left( \frac{(1 - \tau_t) \beta y_t}{\theta_{t+1} h(\tau_t \beta y_t)} \right)^\alpha, \quad (23)$$

and therefore the Lemma follows from the properties of the agriculture production technology,  $F(X, L_t)$ , and the concavity of  $h(e_t)$ .

(b) Since  $\theta_{t+1}$  equalizes the marginal return to labor in the two sectors, and since the marginal product of factors is decreasing in both sectors, part (b) follows.  $\square$

**Corollary 1** *Given land size,  $X$ , prices in period  $t + 1$  are uniquely determined by  $y_t$  and  $\tau_t$ .  
That is*

$$\begin{aligned} w_{t+1} &= w(y_t, \tau_t); \\ R_{t+1} &= R(y_t, \tau_t); \\ \rho_{t+1} &= \rho(y_t, \tau_t). \end{aligned}$$

**Proof.** Follows from (3), (5), (17), (20) and Lemma 1.  $\square$

### 3.4 Efficient Expenditure on Public Education

This section demonstrates that the level of expenditure on public schooling (and hence the level of taxation) that maximizes aggregate output is optimal from the viewpoint of all individuals except for landowners who own a large fraction of the land in the economy.

**Lemma 2** *Let  $\tau_t^*$  be the tax rate in period  $t$ , that maximizes aggregate output in period  $t + 1$ ,*

$$\tau_t^* \equiv \arg \max y_{t+1}$$

(a)  $\tau_t^*$  equates the marginal return to physical capital and human capital:

$$\theta_{t+1} w^M(k_{t+1}) h'(\tau_t^* \beta y_t) = R(k_{t+1}).$$

- (b)  $\tau_t^* = \tau^*(y_t) \in (0, 1)$  and  $\tau^*(y_t)y_t$ , is strictly increasing in  $y_t$ .
- (c)  $\tau_t^* = \arg \max w_{t+1}$  and  $dw_{t+1}/d\tau_t > 0$  for  $\tau_t \in (0, \tau_t^*)$ .
- (d)  $\tau_t^* = \arg \min \rho_{t+1}$  and  $d\rho_{t+1}/d\tau_t < 0$  for  $\tau_t \in (0, \tau_t^*)$ .
- (e)  $\tau_t^* = \arg \max \theta(y_t, \tau_t; X)$  and  $d\theta(y_t, \tau_t; X)/d\tau_t > 0$  for  $\tau_t \in (0, \tau_t^*)$ .
- (f)  $\tau_t^* = \arg \max y_{t+1}^M$  and  $dy_{t+1}^M/d\tau_t > 0$  for  $\tau_t \in (0, \tau_t^*)$ .
- (g)  $\tau_t^* = \arg \max (1 - \tau_t)R_{t+1}$  and  $d(1 - \tau_t)R_{t+1}/d\tau_t > 0$  for  $\tau_t \in (0, \tau_t^*)$ .

**Proof.**

(a) As follows from (16) and (20) aggregate output in period  $t + 1$ ,  $y_{t+1}$  is

$$y_{t+1} = y^M(y_t, \tau_t, \theta_{t+1}) + y^A(\theta_{t+1}; X). \quad (24)$$

Hence, since  $\tau_t^* = \arg \max y_{t+1}$  and since, as established in Lemma 1,  $\theta_{t+1} = \arg \max y_{t+1}$ , it follows from the envelop theorem that the value of  $\tau_t^*$  satisfies the condition in part (a).

(b) It follows from part (a), (5) and (17) that

$$\frac{(1 - \tau_t^*)\beta y_t}{h(\tau_t^*\beta y_t)} = \frac{\alpha}{(1 - \alpha)h'(\tau_t^*\beta y_t)}.$$

Hence,  $\tau_t^* = \tau^*(y_t) < 1$  and  $\tau_t^* > 0$  for all  $y_t > 0$  (since  $\lim_{e_t \rightarrow 0^+} h'(e_t) = \infty$ ) and  $\tau^*(y_t)y_t$  is strictly increasing in  $y_t$ .

(c) Follows from the differentiation of  $w_{t+1}$  in (22) with respect to  $\tau_t$  using the envelop theorem since, as established in Lemma 1,  $\theta_{t+1} = \arg \max w_{t+1}$ .

(d) Follows from part (c) noting that along the factor price frontier  $\rho_t$  decreases in  $w_t^A$  and therefore in  $w_t$ .

(e) Follows from part (c) noting that, as follows from the properties of the production function (2),  $L_{t+1}$  and  $w_{t+1}^A$  are inversely related and hence  $\theta_{t+1} = 1 - L_{t+1}$  is positively related to  $w_{t+1}^A$  and therefore to  $w_{t+1}$ .

(f) Follows from differentiating  $y_{t+1}^M$  in (16) with respect to  $\tau_t$  noting that  $y_{t+1}^M$  is strictly increasing in  $\theta_{t+1}$  and as follows from part (e)  $d\theta(X, y_t, \tau_t)/d\tau_t > 0$  for  $\tau_t \in (0, \tau_t^*)$ .

(g) Follows from part (f) noting that, as follows from (18),  $(1 - \tau_t)R_{t+1} = \alpha y_{t+1}^M/(\beta y_t)$ .  $\square$

The size of the land,  $X$ , has two opposing effects on  $\tau_t^*$ . Since a larger land size implies that employment in the manufacturing sector is lower, the fraction of the labor force whose productivity is improved due to taxation that is designed to finance universal public education is lower. In contrast, the return to each unit of human capital employed in the manufacturing sector is higher while the return to physical capital is lower, since human capital in the manufacturing sector is scarce. Due to the Cobb-Douglass production function in the manufacturing sector the

two effects cancel one another and as established in Lemma 2 the value of  $\tau_t^*$  is independent of the size of land.

Furthermore, since the tax rate is linear and the elasticity of substitution between human and physical capital in the manufacturing sector is unitary, as established in Lemma 2, the tax rate that maximizes aggregate output in period  $t + 1$  also maximizes the wage per worker,  $w_{t+1}$ , and the net return to capital,  $(1 - \tau_t^*)R_{t+1}$ . If the elasticity of substitution would be larger than unity but finite, then the tax rate that maximizes the wage per worker would have been larger than the optimal tax rate and the tax rate that maximizes the return to capital would have been lower, yet strictly positive. If the elasticity of substitution is smaller than unity, the opposite holds.

**Corollary 2** *The optimal level of taxation from the viewpoint of individual  $i$ , is  $\tau_t^*$  for a sufficiently low  $x^i$ .*

**Proof.** Since the indirect utility function, (11), is a strictly increasing function of the individual's second period wealth, and since as established in Lemma 2,  $w_{t+1}$ , and  $(1 - \tau_t)R_{t+1}$  are maximized by  $\tau_t^*$ , it follows from (8) that, for a sufficiently low  $x^i$ ,  $\tau_t^* = \arg \max v(I_{t+1}^i)$ .  $\square$

Hence, the optimal level of taxation for individuals whose land ownership is sufficiently low equals the level of taxation (and hence the level of expenditure on public schooling) that maximizes aggregate output.

### 3.5 Political Mechanism

Suppose that changes in the existing educational policy require the consent of all segments of society. In the absence of consensus the existing educational policy remains intact.<sup>28</sup>

Suppose that consistently with the historical experience, societies initially do not finance education (i.e.,  $\tau_0 = 0$ ). It follows that unless all segments of society would find it beneficial to alter the existing educational policy the tax rate will remain zero. Once all segments of society find it beneficial to implement educational policy that maximizes aggregate output, this policy would remain in effect unless all segment of society would support an alternative policy.

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<sup>28</sup>Clearly, even in democracies, the median voting model is not perfectly applicable. Strong interest groups, such as landowners, exert a larger influence on public policy than their representation in the population. For the sake of simplicity we adopt an extreme modeling approach that provides landowners with a veto power against education reforms. The adoption of some alternative approaches, such as a lobbying model, would not change the qualitative result.



### 3.6 Landlords' Desirable Schooling Policy

Suppose that in period 0 a fraction  $\lambda \in (0, 1)$  of all young individuals in society are Landlords while a fraction  $1 - \lambda$  are landless. Each landlord owns an equal fraction,  $1/\lambda$ , of the entire stock of land,  $X$ , and is endowed with  $b_0^L$  units of output. Since landlords are homogeneous in period 0 and since land is bequeathed from parent to child and each individual has a single child and a single parent, it follows that the distribution of land ownership in society and the division of capital within the class of landlord is constant over time, where each landlord owns  $X/\lambda$  units of land and  $b_t^L$  units of output in period  $t$ .

The income of each landlord in the second period of life,  $I_{t+1}^L$ , as follows from (8) and Corollary 1 is therefore

$$I_{t+1}^L = w(y_t, \tau_t) + (1 - \tau_t)R(y_t, \tau_t)b_t^L + \rho(y_t, \tau_t)X/\lambda, \quad (25)$$

and  $b_{t+1}^L$ , as follows from (10) is therefore

$$b_{t+1}^L = \beta[w(y_t, \tau_t) + (1 - \tau_t)R(y_t, \tau_t)b_t^L + \rho(y_t, \tau_t)X/\lambda] \equiv b^L(y_t, b_t^L, \tau_t; X/\lambda) \quad (26)$$

**Proposition 1** *For any given level of capital and land ownership of each landlord  $(b_t^L, \lambda; X)$  there exists a sufficiently high level of output  $\hat{y}_t = \hat{y}(b_t^L, \lambda; X)$  above which the optimal taxation from a Landlord's viewpoint,  $\tau_t^L$ , maximizes aggregate output, i.e.,*

$$\tau_t^L \equiv \arg \max I_{t+1}^L = \tau_t^* \quad \text{for } y_t \geq \hat{y}_t$$

where  $\hat{y}(b_t^L, 1; X) = 0$ ;  $\lim_{\lambda \rightarrow 0} \hat{y}(b_t^L, \lambda; X) = \infty$ ;

$\hat{y}_\lambda(b_t^L, \lambda; X) < 0$ ;  $\hat{y}_X(b_t^L, \lambda; X) > 0$ .

**Proof.** Follows from the properties of the agriculture production function (2), Lemma 1 and 2, noting that, since  $1 - \theta_{t+1} = \arg \max \rho_{t+1}$ , for  $b_t^L = 0$ ,  $dI_{t+1}^L/dw_{t+1} > 0$  if  $\lambda > 1 - \theta_{t+1}$ .  $\square$

**Corollary 3** *For any given level of capital and land ownership of each landlord  $(b_t^L, \lambda; X)$  there exists a sufficiently high level of output  $\hat{y}_t = \hat{y}(b_t^L, \lambda; X)$  above which the level of taxation,  $\tau_t^*$ , that maximizes aggregate output, is optimal from the viewpoint of every member of society.*

**Lemma 3** (a) *The equilibrium tax rate in period  $t$ ,  $\tau_t$ , is equal to either 0 or  $\tau_t^*$ , i.e.,*

$$\tau_t \in \{0, \tau_t^*\};$$

(b) *If  $\hat{t}$  is the first period in which  $\tau_t = \tau_t^*$  then*

$$\tau_t = \tau_t^* \quad \forall t \geq \hat{t}.$$

**Proof.** follows from the political structure, Corollary 2 and the assumption that  $\tau_0 = 0$ .  $\square$

**Lemma 4** *Landlords desirable tax rate in period  $t$ ,  $\tau_t^L$ ,*

$$\tau_t^L = \begin{cases} \tau_t^* & \text{if } b_t^L \geq \hat{b}_t; \\ 0 & \text{if } b_t^L < \hat{b}_t, \end{cases}$$

where

$$\hat{b}_t = \frac{w(y_t, 0) - w(y_t, \tau_t^*) + [\rho(y_t, 0) - \rho(y_t, \tau_t^*)]X/\lambda}{(1 - \tau_t^*)R(y_t, \tau_t^*) - R(y_t, 0)} \equiv \hat{b}(y_t; X/\lambda),$$

and there exists a sufficiently large  $\lambda$  such that,  $\hat{b}(y_t, X/\lambda) = 0$  for any  $y_t$ .

**Proof.** Follows from (25) and Lemma 3.  $\square$

**Corollary 4** *The switch to the efficient tax rate  $\tau_t^*$  occurs when  $b_t^L \geq \hat{b}_t$ , i.e.,*

$$b_t^L \geq \hat{b}_t \quad \text{if and only if } t \geq \hat{t}.$$

## 4 The Process of Development

This section analyzes the evolution of an economy from an agricultural to an industrial-based economy. It demonstrates that the gradual decline in the importance of the agricultural sector along with an increase in the capital holdings in landlords' portfolio may alter the attitude of landlords towards educational reforms. In societies in which land is scarce or its ownership is distributed rather equally, the process of development allows the implementation of an optimal education policy, and the economy experiences a significant investment in human capital and a rapid process of development. In contrast, in societies where land is abundant and its distribution is unequal, an inefficient education policy will persist and the economy will experience a lower growth path as well as lower level of output in the long-run.

**Proposition 2** *The conditional evolution of output per capita, as depicted in Figure 1, is given by*

$$y_{t+1} = \begin{cases} \psi^0(y_t) \equiv (\beta y_t)^\alpha \theta_{t+1}^{1-\alpha} + F(X, 1 - \theta_{t+1}) & \text{for } \tau = 0; \\ \psi^*(y_t) \equiv [(1 - \tau_t^*)\beta y_t]^\alpha [\theta_{t+1} h(\tau_t^* \beta y_t)]^{1-\alpha} + F(X, 1 - \theta_{t+1}) & \text{for } \tau = \tau^*, \end{cases}$$

where,

$$\psi^*(y_t) > \psi^0(y_t) \quad \text{for } y_t > 0.$$

$$d\psi^j(y_t)/dy_t > 0, \quad d^2\psi^j(y_t)/dy_t^2 < 0, \quad \psi^j(0) = F(X, 1) > 0, \quad d\psi^j(y_t)/dX > 0, \quad \text{and}$$

$$\lim_{y_t \rightarrow \infty} d\psi^j(y_t)/dy_t = 0; \quad j = 0, *.$$

**Proof.** The proof follows from (1), (13), (15), (16) and (20), applying the envelop theorem noting that, as follows from Lemma 1 and Lemma 2,  $\theta_{t+1} = \arg \max y_{t+1}$  and  $\tau_t^* = \arg \max y_{t+1}$ .  $\square$

Note that the evolution of output per capita, given schooling policy, is independent of the distribution of land and income.

**Corollary 5** *Given the size of land,  $X$ , there exists a unique  $\bar{y}^0$  and a unique  $\bar{y}^*$  such that*

$$\bar{y}^0 = \psi^0(\bar{y}^0)$$

and

$$\bar{y}^* = \psi^*(\bar{y}^*)$$

where  $\bar{y}^* > \bar{y}^0$ .

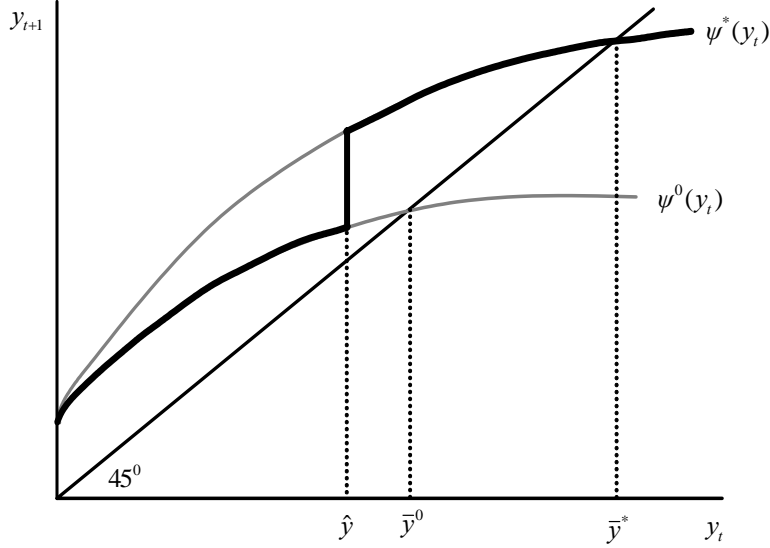


Figure 1: Education Reform and The Evolution of Output

#### 4.1 The Dynamical System

The evolution of output, as follows from Lemma 3 and Proposition 2, is

$$y_{t+1} = \begin{cases} \psi^0(y_t) & \text{for } t < \hat{t} \\ \psi^*(y_t) & \text{for } t \geq \hat{t}. \end{cases}$$

The timing of the switch from a zero tax rate to the efficient tax rate  $\tau_t^*$  occurs, as established in Corollary 4 once  $b_t^L \geq \hat{b}_t$ . Since  $\tau_t = 0$  for all  $t < \hat{t}$ , and since  $\hat{b}_t = \hat{b}(y_t; X/\lambda)$ , the timing of

the switch,  $\hat{t}$ , is determined by the co evolution of  $\{y_t, b_t^L\}$  for  $\tau_t = 0$

$$y_{t+1} = \psi^0(y_t)$$

$$b_{t+1}^L = b^0(y_t, b_t^L)$$

Let the  $bb$  locus (depicted in Figure 3) be the set of all pairs  $(b_t^L, y_t)$  such that, for  $\tau_t = 0$ ,  $b_t^L$  is in a steady state. i.e.,  $b_{t+1}^L = b_t^L$ .

In order to simplify the exposition of the dynamical system it is assumed that the value of  $\beta$  is sufficiently small,

$$\beta < 1/R(y_t, 0) \quad \forall y_t \quad (\text{A1})$$

where as follows from (3), (5) and Lemma 1,  $R(y_t, 0) < \infty$  for all  $y_t$  and therefore there exists a sufficiently small  $\beta$  such that A1 holds.

**Lemma 5** *Under A1, there exists a continuous single-valued function  $\varphi(y_t; X/\lambda)$ , such that along the  $bb$  locus*

$$b_t^L = \varphi(y_t; X/\lambda) \equiv \frac{\beta[w(y_t, 0) + \rho(y_t, 0)X/\lambda]}{1 - \beta R(y_t, 0)} > 0,$$

where for sufficiently small  $\lambda$ ,

$$\varphi(0, X/\lambda) < \hat{b}(0, X/\lambda).$$

and for  $\lambda = 1$

$$\hat{b}(y_t; X/\lambda) < \varphi(y_t; X/\lambda) \quad \text{for all } y_t.$$

Furthermore, as depicted in Figure 3, for  $\tau = 0$ ,

$$b_{t+1}^L - b_t^L \gtrless 0 \quad \text{if and only if } b_t^L \lesseqgtr \varphi(y_t; X/\lambda).$$

**Proof.** Follows from (26), A1, and Lemma 4, noting that for  $\lambda = 1$ ,  $I_t^L = y_t$  and hence  $\tau_t^* = \arg \max I_{t+1}^L$ .  $\square$

Let  $yy^0$  be the locus (depicted in Figure 3) of all pairs  $(b_t^L, y_t)$  such that, for  $\tau_t = 0$ ,  $y_t$  is in a steady state equilibrium, i.e.,  $y_{t+1} = y_t$ .

**Lemma 6**

$$yy^0 = \{(y_t, b_t^L) : y_t = \bar{y}^0, b_t^L \in R_+\}$$

Furthermore, as depicted in Figure 3, for  $\tau = 0$ ,

$$y_{t+1} - y_t \gtrless 0 \quad \text{if and only if } y_t \lesseqgtr \bar{y}^0.$$

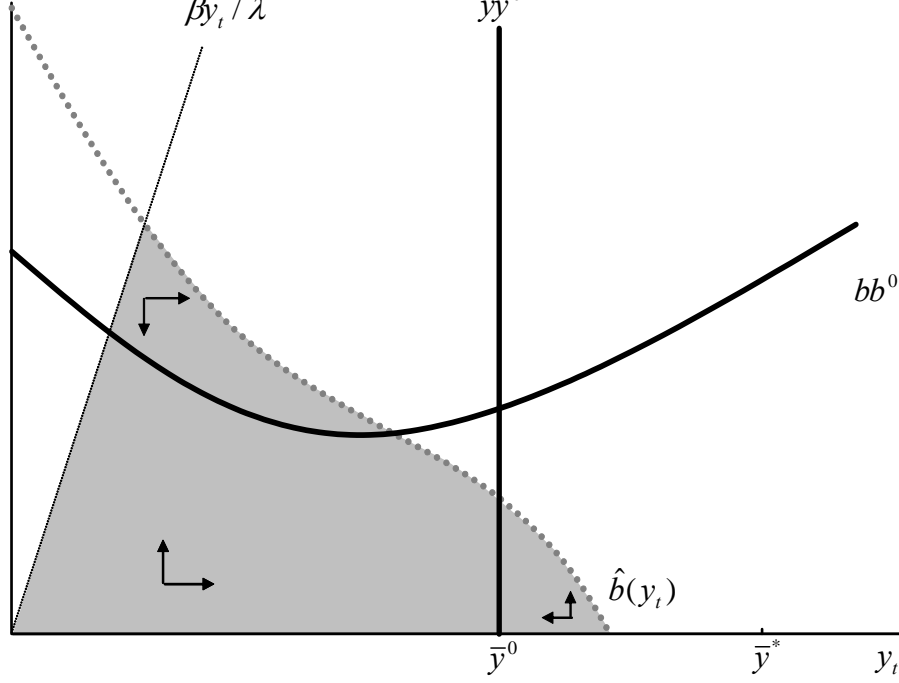


Figure 2: The Evolution of Output and Landowner's Bequest

**Proof.** Follows from Proposition 2 and Corollary 5.  $\square$

**Corollary 6** *For a sufficiently low  $\lambda$  there exists  $y > 0$  such that*

$$\hat{b}(y; X/\lambda) = \varphi(y; X/\lambda).$$

**Proof.** follows from Lemma 5 and Proposition 16.  $\square$

**Lemma 7** *Let  $\tilde{y}(X/\lambda)$  be the smallest value of  $y_t$  such that  $\hat{b}(y_t; X/\lambda) = \varphi(y_t; X/\lambda)$ . Under A1*

$$d\tilde{y}(X/\lambda)/d\lambda \leq 0,$$

*where  $\lim_{\lambda \rightarrow 0} \tilde{y}(X/\lambda) = \infty$ .*

**Proof.** It follows from the properties of  $\hat{b}(y_t; X/\lambda)$  and  $\varphi(y_t; X/\lambda)$ , noting that  $w(y_t, \tau_t)$ ,  $\rho(y_t, \tau_t)$  and  $R(y_t, \tau_t)$ , are independent of  $\lambda$ , and  $\rho(y_t, 0) > \rho(y_t, \tau_t^*)$  for all  $y_t > 0$ .  $\square$

In order to simplify the exposition of the dynamical system it is assumed that  $\tilde{y}(X/\lambda)$  is unique.

**Proposition 3** *The economy is characterized by:*

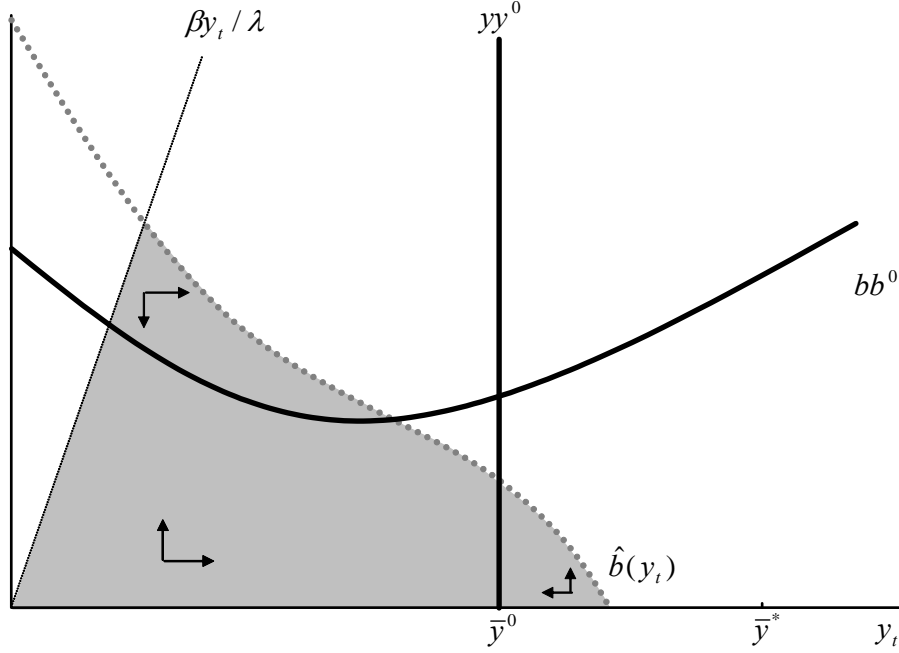


Figure 3: The Evolution of Output and Landowner's Bequest

- (a) A unique globally stable steady state equilibrium,  $\bar{y}^*$ , if  $\tilde{y}(X/\lambda) < \bar{y}^0$ , that is if  $\lambda$  is sufficiently large.
- (b) Two locally stable steady states,  $\bar{y}^*$  and  $\bar{y}^0$ , if  $\tilde{y}(X/\lambda) > \bar{y}^0$ , that is if  $\lambda$  is sufficiently small.

**Proof.** Follows from the political mechanism, the definition of  $\tilde{y}$  and Lemma 5 and 7.  $\square$

**Theorem 1** Consider countries that are identical in all respects except for their initial land distribution.

- (a) Countries that have a less equal land distribution, i.e., countries with a low level of  $\lambda$ , will experience a delay in the implementation of efficient education policy and will therefore experience a lower growth path.
- (b) Countries characterize by a sufficiently unequal distribution of land and sufficiently low capital ownership by the landlord will permanently conduct an inefficient education policy and will therefore experience a lower growth path as well as a lower level of output in the long-run.

**Proof.** The theorem is a corollary of Proposition 3 and Lemma 3 and 7.  $\square$

This theorem suggests that the distribution of land within and across countries affected the nature of the transition from an agrarian to an industrial economy, generating diverging growth patterns across countries. Furthermore, land abundance that was beneficial in early

stages of development, brought about a hurdle for human capital accumulation and economic growth among countries that were marked by an unequal distribution of land ownership. As depicted in Figure 4, some land abundant countries which were associated with the club of the rich economies in the pre-industrial revolution era and were characterized by an unequal distribution of land, were overtaken in the process of industrialization by land scarce countries. The qualitative change in the role of land in the process of industrialization has brought about changes in the ranking of countries in the world income distribution.

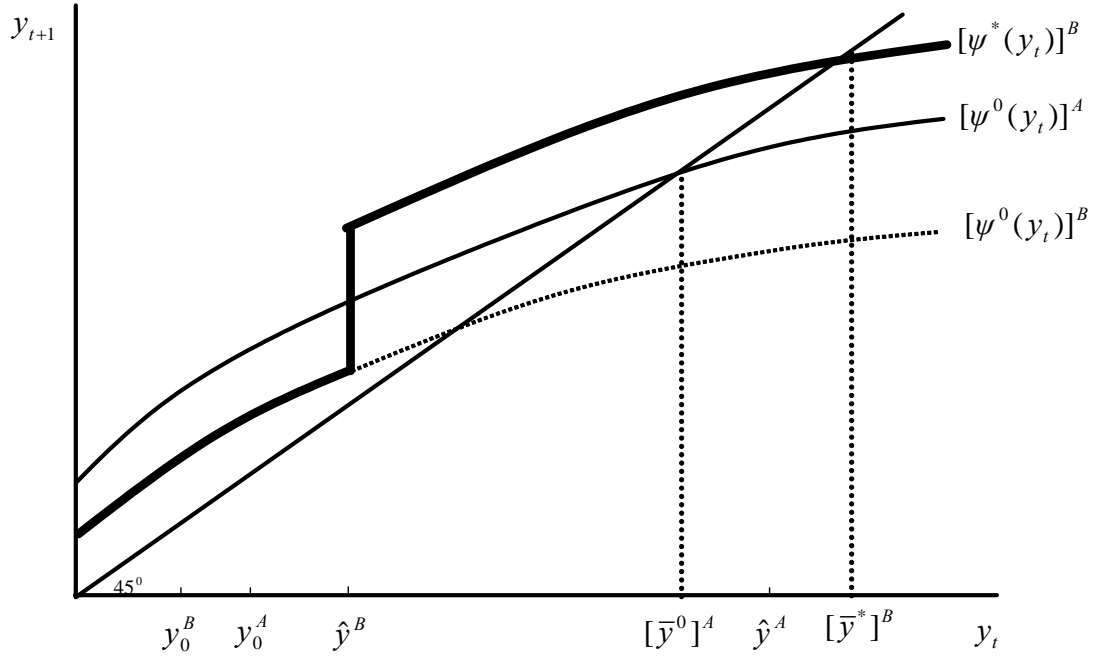


Figure 4: Overtaking – country A is relatively richer in land, however, due to land inequality it fails to implement efficient schooling and is overtaken by country B. Alternatively, for a lower degree of inequality, country A will eventually implement education reforms and ultimately takeover country B (not captured in the figure).

## 5 Concluding Remarks

The proposed theory suggests that land inequality affected the nature of the transition from an agrarian to an industrial economy generating diverging growth patterns across countries. Land abundance, which was beneficial in early stages of development, generated in later stages a hurdle for human capital accumulation and economic growth among countries in which land ownership was unequally distributed. The qualitative change in the role of land in the process

of industrialization affected the transition to modern growth and has brought about changes in the ranking of countries in the world income distribution. Some land abundant countries that were associated with the club of the rich economies in the pre-industrial revolution era and were marked by an unequal distribution of land, were overtaken in the process of industrialization by land scarce countries and were dominated by other land abundant economies in which land distribution was rather equal.<sup>29</sup>

The theory abstracts from the sources of distribution of population density across countries in the pre-industrialization era. The Malthusian mechanism, that positively links population size to effective resources in each region, suggests that the distribution of population density in the world economy should reflect in the long run the distribution of productive land across the globe. Hence, one could have argued that significant economic variations in effective land per capita in the long run are unlikely. Nevertheless, there are several sources of variations in effective resources per-capita in the pre-industrial world. First, due to rapid technological diffusion across countries and continents in the era of “innovations and discoveries” (e.g., via colonialism) population size in the technologically receiving countries has not completed its adjustment prior to industrialization, and the population density in several regions was therefore below its long-run level. Second, inequality in the distribution of land ownership within countries (due to geographical conditions, for instance) prevented population density from fully reflecting the productivity of land. Variations in population density across the globe may therefore reflect variations in climate, settlement date, disease, colonization, and inequality.

The theory suggest that geographical conditions that were associated with increasing returns in agricultural or in the extraction of natural resources led to the emergence of a class of wealthy landlords that ultimately affected adversely the implementation of human capital promoting institutions. Furthermore, geographical conditions were the prime determinant of the timing of the agricultural revolution [Diamond (1997)] and due to the interaction between technological progress and population growth [Malthus (1789) and Boserup (1965)] the cause

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<sup>29</sup>Acemoglu et al. (2002) argue that low population density in 1500 was beneficial for the implementation of growth promoting institutions. Thus, one can mistakenly conclude that their findings may contradict the hypothesis regarding the adverse effect of land abundance (as measured by *effective* land per capita) on the implementation of education reforms. However, in the Malthusian regime that characterized the world prior to 1500, population growth was positively affected by the level of income per capita, and variations in population density across countries and regions reflected differences in technologies and land quality, rather than differences in effective land per capita. In particular, population density reflected land quality (broadly defined) and should not be interpreted as an index for land scarcity. Moreover, the proposed theory suggests that the effect of land abundance on the implementation of growth promoting institutions depends critically on the degree of land inequality which is not controlled by Acemoglu et al. (2002). In particular, it is possible that the same geographical conditions that led to higher population density permitted higher land inequality implying that their findings may in fact be consistent with the theory developed in this paper.



of variation in the level of technology and population density, in geographically isolated regions despite similar levels of output per capita. Hence, the link that was created between geographically isolated areas in the era of discoveries, and the associated diffusion of technology, generated geographically-based variations in effective land per capita, that according to the proposed theory led to differences in the implementation of human capital promoting institutions.

The paper implies that differences in the evolution of social structures across countries may reflect differences in the distribution of land ownership. In particular, the dichotomy between workers and capitalists is more likely to persist in land abundant economies in which land ownership is unequally distributed. As argued by Galor and Moav (2006), due to the complementarity between physical and human capital in production, the Capitalists were among the prime beneficiaries of the accumulation of human capital by the masses. They had therefore the incentive to financially support public education that would sustain their profit rates and would improve their economic well being, although would ultimately undermine their dynasty's position in the social ladder and would bring about the demise of the capitalist-workers class structure. As implied by the current research, the timing and the degree of this social transformation depend on the economic interest of landlords. In contrast to the Marxian hypothesis, this paper suggests that workers and capitalists are the natural economic allies that share an interest in industrial development and therefore in the implementation of growth enhancing human capital promoting institutions, whereas landlords are the prime hurdle for industrial development and social mobility.

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